


COLORADO DEPARTMENT OF PUBLIC HEALTH & ENVIRONMENT WATER QUALITY CONTROL DIVISION Safe Drinking Water Program	Safe Drinking Water Program Policy Number: DW-003
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	REVISION: Revises/ replaces DWTR-6 (also known as DW-003)
TITLE: Determination of Groundwater Under the Direct Influence (GWUDI) of Surface Water	APPROVED BY
	Approved By :  Ron Falco, P.E. Safe Drinking Water Program Manager

1.0 Basis and Purpose

The purpose of this policy is to describe the methodology used by the Department to classify drinking water supply sources as either groundwater or groundwater under the direct influence of surface water (GWUDI).

The Colorado Primary Drinking Water Regulations¹ (CPDWR) in Article 7.1.3(d) states:

“Once a groundwater source has been determined, through the results of an MPA (Microscopic Particulate Analysis), visual well inspection or correlation of source water parameters with surface conditions, to be under the direct influence of surface water, the system must install filtration treatment...”

The correct classification (or reclassification) of water sources as GWUDI may have significant public health protection benefits but also potentially large financial, operational, and compliance implications for public water systems. The Department strives to be consistent and fair with each water system when determining whether or not a source is GWUDI. While, the Department will base determinations on data and the objective analysis of the data, if data are inconclusive, the Department will act in the interest of protecting public health.

2.0 Applicability

This policy is applicable to all Department classifications of a public water system's source water as groundwater or GWUDI. The definition of public water system is found in the CPDWR1 Article 1.5.2 (Definitions) and Article 1.2 (Applicability).

3.0 Authority

Authority for this policy is granted by the CPDWR¹ in Article 1.6.2 (Performance Testing), Article 7.1.3 (Filtration), and Article 7.1.4 (Monitoring Requirements). The Colorado Department of Public Health and Environment (the Department) will use this policy to evaluate and determine whether a public water system drinking water supply source is either groundwater or GWUDI. Additionally, Article 1.6.2 grants the Department's authority to require performance tests and monitoring as the Department deems necessary to protect public health and establish compliance with the CPDWR.

4.0 Definitions

4.1 Aquifer recharge

Aquifer or groundwater recharge is a hydrologic process where water moves downward from surface water to groundwater. Recharge occurs both naturally (through the water cycle) and anthropologically (i.e., "artificial aquifer recharge"), where rainwater and or reclaimed water is routed to the subsurface.

4.2 Confining layer

A geologic zone that inhibits the flow of groundwater to or from an adjacent aquifer because of its impermeability or low permeability. For the purposes of GWUDI evaluation, confining layers are defined as laterally extensive geologic zones having low hydraulic conductivities of less than 10^{-6} centimeters per second (cm/s).

4.3 Gallery type wells and Infiltration galleries

Gallery type wells, also referred to as hand dug wells, are wells constructed without the use of a drilling rig, but typically involve the use of other machinery such as backhoes. Gallery type wells are often wide, shallow wells that are lined with cement enclosures. Gallery type wells are often constructed in alluvial (Type III) aquifers.

Infiltration galleries are engineered structures that are constructed to intercept alluvial groundwater or surface water. Infiltration galleries are often constructed in alluvial (Type III) aquifers near surface water bodies.

It is the Division's experience that existing infiltration galleries and gallery type wells may or may not have a well permit from the Office of the State Engineer.

4.4 Groundwater

Any water beneath the surface of the ground which is neither surface water nor GWUDI.

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4.5 Groundwater flowpath length

The measured horizontal distance from the water source, e.g. a well, to the edge (at median stream flow or lake stage conditions) of the nearest surface water body.

4.6 Groundwater quality performance testing

Performance testing that records water quality characteristics which can include, but is not limited to, temperature, turbidity and conductivity changes over time relative to nearby water sources or precipitation events.

4.7 Groundwater under the direct influence (GWUDI)

Any water beneath the surface of the ground with:

- Significant occurrence of insects or other macroorganisms, algae, or large-diameter pathogens such as *Giardia lamblia* or *Cryptosporidium*; or
- Significant and relatively rapid shifts in water quality parameters such as turbidity, temperature, or conductivity which closely correlate with adjacent surface water or climatological conditions; or
- Any source (well) that was unable to pass a visual well inspection

is considered to be GWUDI. GWUDI is classified as surface water under CPDWR¹.

4.8 Office of State Engineer Well Permit

A well permit is issued by the Office of the State Engineer² for constructing a new well and the repair, replacement, or modification of an existing well (Sections 37-90-105(3)(a)(I), 37-90-108(1)(a), 37-90-137(1), 37-90-138(3), and 37-92-602(3)(a) Colorado Revised Statutes (C.R.S.)).

4.9 Springs

A spring is a water source that naturally flows from a rock or soil formation onto the land surface or into a body of water without any engineered modifications to the source. However, engineering modifications may be needed to protect a spring from surface runoff for it to be considered groundwater under this policy. Many water sources in Colorado that have been considered springs in the past may actually be a gallery type wells or other water collection devices. Spring sources usually are not required to be permitted as a well by the Office of the State Engineer.

4.10 Surface Water

Any water source that is open to the atmosphere and subject to surface runoff. GWUDI is classified as surface water under CPDWR¹.

4.11 Time of travel

An estimate of the time it takes for water to move from a specific point or surface feature, such as a surface water body, to another specific point, such as a target well. Time of travel is calculated using a derivative of Darcy's Law. The calculation is for porous media aquifers and assumes a homogenous and isotropic aquifer with no regional groundwater flow. The calculation may be appropriate for sources in Type III aquifers. Sources in Type II aquifers should not use this calculation. Other appropriate calculations of average travel time will be reviewed and approved by the Department on a case-by-case basis.

The derivative of Darcy's Law used for this calculation is:

$$t = \frac{\pi H n R^2}{Q}$$

R = radius of capture zone H = thickness of production zone (screened interval)
Q = pump rate of source n = porosity of the aquifer
t = time of travel π = pi

4.12 Type I aquifer

Aquifers located beneath a confining layer are designated by the Office of the State Engineer as Type I Aquifers². Type I aquifers consist of unconsolidated or consolidated rock material or crystalline rocks below a confining layer.

4.13 Type II aquifer

Aquifers located in unconfined bedrock are designated by the Office of the State Engineer as Type II Aquifers².

4.14 Type III aquifer

Aquifers located in unconsolidated rock are designated by the Office of the State Engineer as Type III Aquifers². Type III aquifers consist of unconsolidated rock material including alluvial and/or colluvial deposits and severely weathered (decomposed) crystalline rocks.

4.15 Source depth

The vertical distance from ground level to the top of the well screen; depth to uppermost screened interval in a well; the distance from ground level to the top of the static water level.

5.0 Methodology for Determination of GWUDI

5.1 General Provisions

- 5.1.1 Public water system owners/operators are responsible for providing the Department with the information and/or data needed to make an accurate GWUDI determination of the source under consideration.
- 5.1.2 Existing sources may be identified for GWUDI evaluation in multiple ways. These include, but are not limited to: sanitary surveys, design reviews, compliance evaluations, data analysis, and complaints.
- 5.1.3 If a source is determined to be GWUDI, the system will be required to comply with all sections of CPDWR¹ Article 7 (Surface Water Treatment Rule). Any performance testing done during the GWUDI determination process does not relieve a source newly classified as GWUDI from any of the testing/sampling requirements under CPDWR 7.1, 7.2, 7.3 or 7.4.
- 5.1.4 The Department will provide written notification regarding GWUDI evaluation findings. Reevaluation of the source will typically not occur, unless changing conditions merit. However, the Department retains authority under Article 7 of the CPDWR¹ to evaluate and classify sources at its discretion.
- 5.1.5 Systems may request a re-evaluation of existing groundwater or GWUDI source(s) if changing circumstances or new data justify a re-evaluation. If the request is granted, the Department will follow the criteria in this policy to re-evaluate the source(s).
- 5.1.6 The Department recognizes that not all sources can be clearly identified as a specific aquifer type, spring, gallery type well or infiltration gallery. In those instances, the Department will consider the source an indeterminate source type and the source will be treated as if it were a Type II aquifer source for the purposes of GWUDI evaluation.

5.2 Sources in Type I Aquifers

- 5.2.1 Due to the presence of a confining layer between the aquifer and the surface, the Department classifies all new, discovered and existing sources in Type I aquifers as groundwater sources.

5.3 Sources in Type II and Type III Aquifers

- 5.3.1 All existing sources in Type II and Type III aquifers will retain their current groundwater or GWUDI classification unless identified as needing a GWUDI evaluation under section 5.1.2.
- 5.3.2 The Department requires a GWUDI evaluation of all new or discovered sources in Type II and Type III aquifers.

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- 5.3.3 In the case of evaluating the GWUDI status of a proposed replacement (i.e., 'redrill') well, the Department will accept performance data or ground water model results from, or based on, the existing well in assessing the new redrilled well's status provided that the redrilled well is constructed at the same (or greater) distance from surface water and aquifer recharge activities; with the same (or deeper) depth to top of uppermost screen; and will be operated with a similar pumping regime.
- 5.3.4 In the case where multiple wells are being or will be installed, the Department will provide guidance on the subset of wells that require performance testing. The Department recognizes that not every well in a well field of closely spaced and similarly constructed wells requires testing.

5.4 **Gallery Type Wells and Infiltration Galleries**

- 5.4.1 All existing gallery type wells and infiltration galleries, at regulated public water systems, that are classified as groundwater will retain groundwater classification until a GWUDI evaluation is performed, at which point, the source will be reclassified as GWUDI.
- 5.4.2 Due to their high-risk nature, the Department will classify all new or discovered gallery type wells and infiltration galleries as GWUDI.

5.5 **Springs**

- 5.5.1 The Department classifies all new, discovered and existing spring sources, at regulated public water systems, as groundwater sources provided they have sufficient engineering modifications needed to protect the spring from surface runoff.

5.6 **GWUDI Evaluation**

- 5.6.1 The Department will initially evaluate a Type II and Type III aquifer source using the following groundwater evaluation screening criteria:
 - (a) The source has adequately passed a visual well inspection; and
 - (b) The source depth is greater than 50 ft; and
 - (c) The groundwater flowpath length is greater than 500 ft; and
 - (d) Aquifer recharge activities are occurring at greater than 500 ft from the source; and
 - (e) If the source is in a Type III aquifer, time of travel must be greater than 50 days.
- 5.6.2 The Department will accept source depth measurements based on the Well Construction and Testing Report recorded by the Office of the State Engineer and the Department will accept groundwater flowpath length

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measurements based on the Department of Water Resources Aquamap online mapping tool.

- 5.6.3 The Department will evaluate source depth of less than 50 feet on a case-by-case basis.
- 5.6.4 The Department will evaluate groundwater flowpath length of less than 500 feet from a source on a case-by-case basis.
- 5.6.5 The Department will evaluate anthropogenic recharge activities that occur less than 500 feet from a source on a case-by-case basis. The assessment will consider the volume of recharge, water source pumping rates, and aquifer characteristics.
- 5.6.6 The time of travel for sources in Type III aquifers can be calculated using Darcy's Law or an accepted variant of Darcy's Law, a ground water model, or some other approved method.
- 5.6.7 If the source cannot meet the groundwater evaluation screening criteria in 5.6.1, the Department may, at its discretion, classify a source as temporarily groundwater. If the Department does not grant temporary groundwater status then the source will be classified as GWUDI. This temporary classification is for a period of one year during which time the system must demonstrate that the source is groundwater by either:
 - (a) conducting groundwater quality performance testing as described in Section 5.7; or
 - (b) conducting groundwater modeling as described in Section 5.8.
- 5.6.8 If the source has been classified as temporary groundwater and the system does not submit data or a model that is sufficient to make a GWUDI determination, the source will be classified as GWUDI based on visual inspection alone.
- 5.6.9 Classification as GWUDI may occur at any time if it is apparent that the system is not making progress toward completing 5.6.8(a) or 5.6.8(b).

5.7 **Groundwater Quality Performance Testing**

- 5.7.1 The results of the performance testing must demonstrate that the source is groundwater as described in 5.7.4; otherwise it will be classified as GWUDI.
- 5.7.2 The system must conduct performance testing with the source operating under normal conditions and under standard operating procedures.
- 5.7.3 The system must conduct the groundwater quality performance testing using locations, frequencies and dates as specified in Table 1.

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- 5.7.4 The Department will evaluate the groundwater quality performance testing results to determine if the source meets the criteria for groundwater. Specifically:
- (a) MPA³ or total coliform data must demonstrate that there is no significant occurrence of insects or other macroorganisms, algae, or large-diameter pathogens such as *Giardia lamblia* or *Cryptosporidium*; and
 - (b) groundwater quality performance testing data must demonstrate that there are no significant or relatively rapid shifts in water quality parameters such as aerobic spores, turbidity, temperature, or conductivity which closely correlate with adjacent surface water or climatological conditions.
- 5.7.5 If the Department determines that the performance data collected by a system are inconsistent in a manner that sampling or laboratory errors are suspected, the Department may require additional performance testing from the system. In cases where the performance data are considered inconclusive, the Department may ask the system to supplement the performance dataset.
- 5.7.6 The Department may, on a case by case basis and at its discretion, modify the requirements of Table 1 based on site specific conditions, laboratory availability, or site specific technical/financial considerations.

Table 1: Groundwater Quality Performance Testing Requirements

<u>Parameter</u>	<u>Location</u>	<u>Frequency</u>	<u>Sampling Dates</u>
Temperature, turbidity and conductivity	Well and surface water (if available)	2 times per 7-day period	March 1st – Oct. 31st
Total Coliform (with E.Coli)	Well	1x month	March 1st – Oct. 31st
Total aerobic bacterial spores	Well and surface water	3 times as specified (concurrently with MPAs)	March 1 st - April 30th July 1st - August 31st Sept. 1 st - Oct. 31 st
Microscopic Particulate Analysis (MPA)*	Well (surface water may also be required on a case by case basis)	3 times as specified	March 1 st - April 30th July 1st - August 31st Sept. 1 st - Oct. 31 st
EPA Method 1622/1623 (<i>Giardia</i> and <i>cryptosporidium</i>)	Case by case	Case by case	Case by case

*When taking the MPA sample, the system must take a paired total aerobic bacterial spore sample.

5.8 **Groundwater Model as a Method to Determine Time of Travel**

- 5.8.1 Water systems may submit time of travel determinations based on an approved groundwater model. The model provided to the Department must:
- include a description of the model used; and
 - include the analytical elements or boundary conditions that were used in building the model; and
 - show that the model takes into account the direction of groundwater flow, soil type, and pumping rate.
- 5.8.2 If the Department does not approve the groundwater model, the source will be classified as GWUDI.
- 5.8.3 The Department will not develop groundwater models for systems.
- 5.8.4 Only sources located in Type III aquifers are eligible for groundwater modeling. Type II Aquifer sources must use performance testing as defined in Section 5.7.
- 5.8.5 If the model demonstrates that the Type III aquifer source meets the time of travel criterion of greater than 50 days and there is no other compelling evidence to classify the system as GWUDI, it will be classified as groundwater; otherwise it will be classified as GWUDI.

6.0 **Deviation from Policy**

- 6.1 Deviations from this policy are governed by WQCD Policy 1: Implementation Policy Framework.
- 6.2 Deviations from Rules and Regulations for Water Well Construction are outside of the scope of this Policy and will not be approved.

7.0 **References**

1. Colorado Department of Public Health and Environment, 5 CCR 1003-1, Colorado Primary Drinking Water Regulations, effective November 30, 2010.
2. State of Colorado Office of the State Engineer, 2 CCR 402-2, Rules and Regulations for Water Well Construction, Pump Installation, Cistern installation, and Monitoring and Observation Hole/Well Construction (Water Well Construction Rules), January 1, 2005.
3. MPA may consist of either traditional groundwater MPA or the proposed MPA protocol from the WRF MPA Study (2010) outlined in the appendix consisting of analysis for Giardia, Cryptosporidium, diatoms, green Algae, total aerobic spores.

